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Glider-based Observations of Kuroshio Seasonal Variability and Loop-Current Intrusion into the South China Sea

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LONG-TERM GOALS

Two long-term goals, one technical and one scientific motivate this project. The technical goal is to advance techniques of observing the upper ocean, in this case proving the utility of underwater gliders. The scientific goal is to understand the effects of mesoscale processes on larger scales such as the general circulation, and on smaller scales such as internal waves.

OBJECTIVES

The proposed observational program focuses on understanding:

- Dynamics of a strongly forced western boundary current encountering a wide strait.
- The intruding current's role in governing mesoscale and internal wave activity.
- Mesoscale response to strong monsoonal forcing.
- Mesoscale modulation of near-inertial and nonlinear internal wave generation and propagation.

APPROACH

A novel application of maturing autonomous glider technologies will allow simultaneous occupation of multiple sections along approximately 1000 km of the Kuroshio's pathway (from Luzon to Ryukyu Islands). Gliders are small, reusable, long-range (3000 – 4000 km) autonomous underwater vehicles designed to glide from the ocean surface to as deep as 1000 m and back while collecting profiles of temperature, salinity, dissolved oxygen concentration and optical properties. Gliders steer through the water by controlling attitude (pitch and roll) and can thus navigate between waypoints to execute survey patterns; or they hold station while profiling and collect Eulerian time series as a 'virtual mooring'. Mission durations depend largely on ambient stratification and profile depth, but typically range from 2–6 months. Gliders are commanded remotely and report their measurements via Iridium satellite telephone at the conclusion of each dive. The vehicles also archive all data to onboard storage for delayed mode transmission or post-recovery interrogation. They use GPS navigation at the sea surface to dead reckon toward commanded targets. Navigation and knowledge of vehicle buoyancy and pitch angle allows estimation of depth-averaged current and suitably energetic vertical velocity

fluctuations. Gliders have been deployed and recovered from a wide range of platforms including small rubber boats, chartered fishing vessels and large research ships.

Craig Lee of University of Washington is an equal partner in this collaborative project. All operations will be joint efforts, with the expectation that collaboration will produce efficiencies. David Tang of Taiwan will aid with local logistics, including providing vessels for glider recovery, if necessary.

WORK COMPLETED

This project is in its earliest stages, as funding arrives just one month prior to the writing of this report. However, planning is well underway, and a firm operational schedule is emerging. We have requested R/V Melville for the following dates:

1. 18-25 April 2007. Deploy 2 gliders off Luzon (Kaosiung to Kaosiung)
2. 11-20 July 2007. Recover 2 in international waters northeast of Taiwan, deploy 4 gliders off Luzon. (Keelung to Kaosiung).
3. 1-10 October 2007. Recover 4 in international waters northeast of Taiwan, deploy off Luzon. (Keelung to Kaosiung).

SIO and UW will each be responsible for half of the deployed gliders. So the first deployment will include one SIO Spray glider and one UW Seaglider.

A planning meeting is scheduled for November 2006 in Taiwan. This meeting will allow us to complete planning with international colleagues.

RESULTS

Results await the successful completion of the coming year's observational program.

IMPACT/APPLICATIONS

The demonstration of glider utility in a strong western boundary current, if successful, will have an impact on future glider operations.

RELATED PROJECTS

This project takes advantage of glider technology that has been developed through grants from several agencies including ONR, NSF, and NOAA.